FINAL REPORT

STATE OF ILLINOIS

W-63-R(SI)-31 STUDY VI JOBS A, B, and C

Project Period: July 1, 1986 through June 30, 1989

Study VI: Investigation in heavy metals, toxic contaminants and disease as related to white-tailed deer in Illinois.

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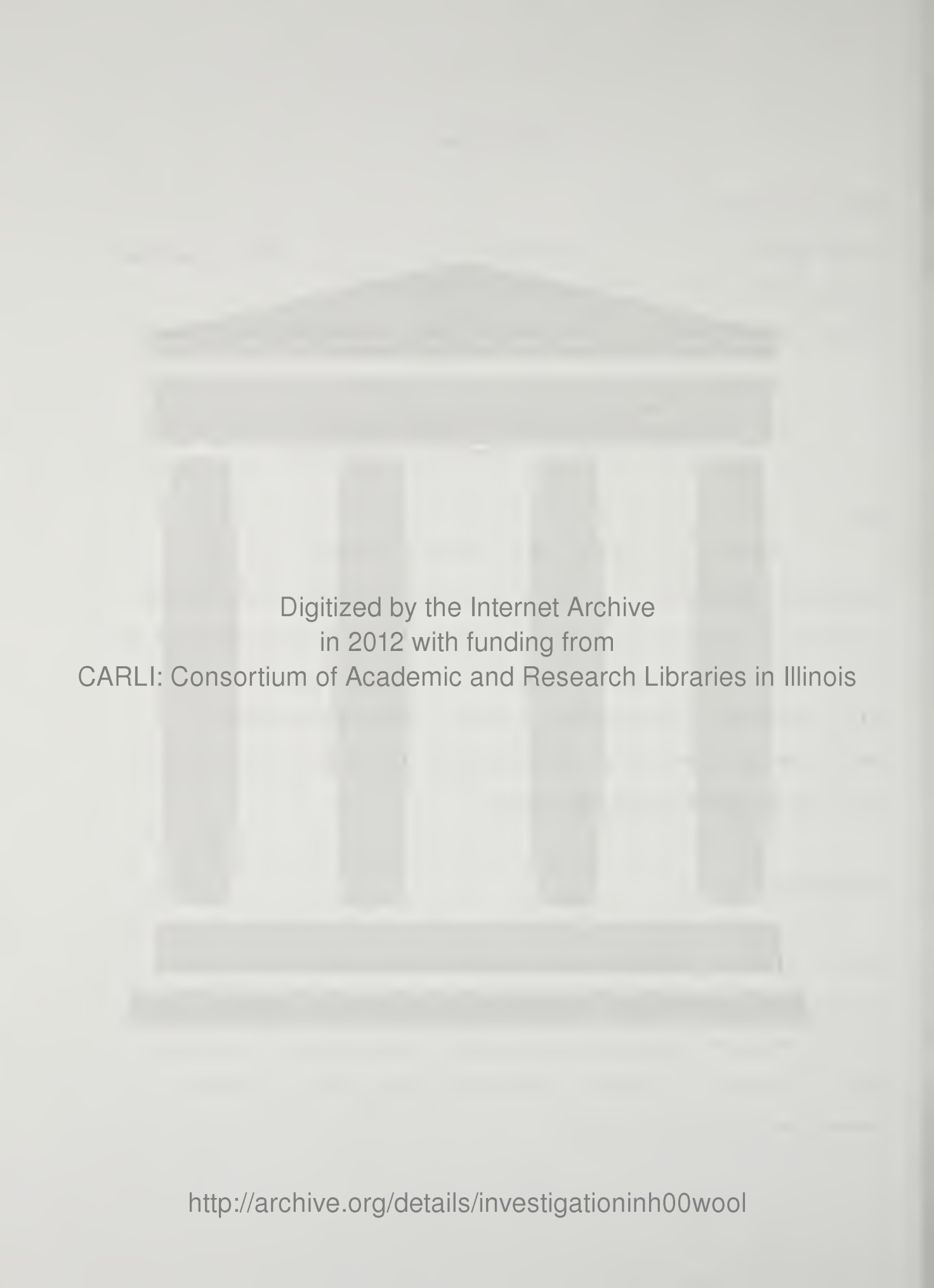
Need:

Investigations of diseases and herd health of white-tailed deer (Odocoileus virginianus) in Illinois are important not only to insure the welfare of the species, but also to safeguard state livestock industries and state residents. The abundance of healthy wild animals usually coincides with environmental quality, while conversely, diseases in wildlife populations often serve as an early warning of environmental problems that could endanger human health and welfare.

Objectives:

To determine and monitor the health status of selected white-tailed deer herds in Illinois; to evaluate herd health problems reported by field personnel; to determine key epizootiological features and importance of diseases detected by the monitoring program; and to monitor environmental quality in Illinois as reflected in levels of heavy metals and chemical residues present in deer tissues.



EXECUTIVE SUMMARY

This project represents surveys of an ongoing nature that do not require a final report. However, this report was prepared to summarize pertinent data previously reported in Quarterly and Annual Federal Aid Performance Reports submitted over the project period.

Analyses for selected heavy metals (Cd, Cu, Mn, Ni, Pb, and Zn) were completed on a total of 1,290 liver samples collected from deer throughout Illinois. All livers collected were from apparently healthy deer, and levels detected were within normal/expected ranges for deer and domestic livestock. However, metal concentrations found in Crab Orchard NWR deer had significantly higher liver concentrations of Cu, Mn, Ni, and Pb than deer from other regions in Illinois. This finding illustrates the value of biological monitors to detect areas of metal contamination. Other regional analyses covered too broad an area to detect small contaminated sites, but did establish useful regional baselines for comparisons over time. Results were reported in the Annual Performance Report, W-63-R(SI)-30, Study VI, 1981 and are not included in this report.

Serological surveys to detect exposure to selected infectious diseases were conducted routinely each year. Special emphasis was placed on monitoring for Hemorrhagic Disease (HD) activity. In addition to monitoring the sentinel herd and selected counties, statewide surveys of bovine and deer were conducted in 1986.

An outbreak of HD occurred in Illinois in Fall 1988 and special efforts were made to obtain sera samples from deer harvested in counties where HD mortality was documented or suspected. Harvest data from the 1988 Firearms deer season were examined retrospectively to assess severity of the outbreak.

The HD outbreak did not appear to cause significant mortality as evidenced by harvest rates and hunter success.

Overall health of the Illinois white-tailed deer herd remained excellent during the project period. Other than the HD outbreak in 1988, reported instances of disease were rare and few animals were submitted for necropsy. Serological surveys did not reveal prevalence of exposure to infectious agents that potentially could pose threat to the deer herd, domestic livestock, or human health.

JOB VIA. Herd and Environmental Monitoring

Objectives: To determine occurrence and prevalence of infectious diseases in the deer herd; to use white-tailed deer as a "sentinel" species to monitor levels of selected heavy metals and toxic chemicals over time and in various regions of Illinois; and, to investigate reported natural deaths of "die-offs" of deer anywhere in Illinois.

INTRODUCTION AND METHODS

Infectious diseases monitored by serosurveys included brucellosis, hemorrhagic disease (HD), tularemia, and vesicular stomatitis (VS). Pilot studies were begun to detect evidence of Lyme disease activity in Illinois. Sera was collected from hunter harvested deer at check stations. Serum was separated by centrifugation, separated into 2 aliquots, and stored frozen at -70°C. in plastic vials until tested. Diagnostic testing was conducted by the Illinois Bureau of Animal Disease Laboratory-Centralia (HD, VS, and brucellosis); Dr. Morris Cooper, SIUC School of Medicine (tularemia); and Dr. Carl Kirkpatrick, Univ. Illinois College Vet. Med. (Lyme disease). Dr. L. Hungerford (Univ. Illinois College Vet. Med.) provided samples and collaborated in the 1985-85 statewide deer and cattle testing for HD.

RESULTS AND DISCUSSION

Brucellosis

Sera samples (n=170) collected from the sentinel deer herd at Crab Orchard NWR during the 1987 Firearms deer season were all negative for brucellosis. In response to public concerns about the origin of brucellosis in local cattle, the Illinois Department of Agriculture (D. Reynolds, Director, Animal Disease Laboratory, Centralia) arranged to sample specimens collected by cooperating hunters in Jefferson and Clay counties. A total of 64 samples (34 from Jefferson and 30 from Clay counties) was received at check stations, but 6 were not usable. All samples were negative for brucellosis. Although it is well established that deer are not reservoirs of bovine brucellosis, public concern is persistent and warrants such periodic monitoring.

Tularemia

A total of 85 sera samples collected from the sentinel herd in fall 1988 was tested to detect the presence of IgG antibody to tularemia using an ELISA assay (developed in Dr. M. Cooper's laboratory, SIUC School of Medicine). Only 1 positive sample (1.2%) was found at a 1:100 dilution considered diagnostic. Only 1 of 185 samples collected in fall 1987 was seropositive at 1:100 dilution. These prevalences of seropositive animals are much lower than results of serological testing of other deer herds reported by Rosen (1981). Although tularemia is known to be enzootic in rabbits in the area, there is apparently negligible "spill-over" into the deer herd. Further testing is not warranted in light of the extremely low seroprevalence detected.

Vesicular Stomatitis (VS)

Serosurveys of the sentinel herd for VS activity began in 1985. However, the hemolyzed samples collected from hunter harvested deer at the check station yielded unreliable results by serum neutralization testing. In 1986, cooperating hunters were given blood collection tubes to improve sera quality. Tests on 190 sera detected low titers (<1:16) in only 3 animals. In 1987, sera samples from 170 deer were tested; none had titers >1:64. One sample was positive to VS-NJ at 1:64, but was negative at 1:128. According to Fletcher et al. (1985), the low titers detected are not diagnostic of VS activity. Based on these results, further sampling does not appear warranted.

Lyme Disease

Illinois currently has a low incidence of reported cases of Lyme disease in humans, but the Illinois Department of Public Health made it a reportable disease in 1988 and 12 cases were reported. Wisconsin is recognized as an endemic focus of Lyme disease and incidence in the upper Midwest is increasing (Kazmierczak and Burgess 1989). Because of the important role that deer play in the epizootiology of Lyme disease, a pilot study was undertaken in collaboration of Drs. C. Kirkpatrick and U. Kitron (Dept. Pathobiology, College Vet. Med., Univ. Illinois) to detect evidence of the disease in Illinois. Canine serology (n=517) detected seropositive animals; prevalence of exposure declined from 11% in the north to 4% in the south (C.Kirkpatrick, unpubl. data). Origin and travel history of the dogs sampled was unknown, so the data should not be interpreted to represent exposure associated with the sampling sites in Illinois. However, based on these findings and detection of the principal vector (Ixodes dammini) in 8 Illinois

counties (U. Kitron, unpubl. data), further surveillance is warranted. Sera samples collected during the 1988 Firearms Deer Season have been stored pending development of testing capabilities at the Centralia Animal Diagnostic Laboratory.

Hemorrhagic Disease (HD)

Monitoring for HD (note: the term hemorrhagic disease includes the diseases caused by either bluetongue virus (BT) or epizootic hemorrhagic disease virus (EHD) which are clinically, pathologically, and epidemiologically indistinguishable) included the sentinel herd at Crab Orchard NWR in 1986-87-88; statewide sampling of cattle and deer in 1985/86; and additional sampling of selected counties in 1988. Results of serosurveys are presented in Job VIB.

JOB VIB. Epizootiology of Infectious Diseases

Objective: To determine administrative actions and management alternatives to deal with outbreaks of disease based on epizootiological and pathological features of a disease.

INTRODUCTION AND METHODS

An outbreak of hemorrhagic disease (HD) occurred in Illinois beginning September 1988. As soon as the outbreak was reported and HD suspected, arrangements were made to obtain as many field reports and diagnostic specimens as possible. Illinois Department of Conservation staff led these efforts. Based on preliminary field reports followed by laboratory diagnoses, sera sampling for the Firearms Deer Season was planned to supplement routine surveillance. Deer check station operators at counties

where HD occurrence was known or suspected were instructed to monitor deer for evidence of convalescent or chronic HD. Following the hunting season, harvest data from selected counties were examined to compare hunter success and harvest with 1987 data as a retrospective indication of severity of the HD outbreak. Finally, serology and diagnostic data were compiled to identify epizootiological features of previous HD activity and the 1988 outbreak in Illinois.

RESULTS AND DISCUSSION

HD activity has been monitored in Illinois annually since 1981 (Table 1). Seroprevalence of BT and EHD viruses in the sentinel herd in southern Illinois was low (≤3.9%) throughout the sampling period. The highest seroprevalences (16.7 and 14.5%) of BT activity detected were in 2 cattle herd that grazed on Crab Orchard NWR in 1981. However, sampling of herds on the refuge in 1984 did not detect BT activity and only 1.9% were seropositive to EHD.

Sera extracted from livers of 370 harvested deer from 94 counties in 1985 similarly revealed very low HD activity; only 0.5% were seropositive to EHD and none to BT. Sera from 400 adult cattle were obtained from the Illinois market cattle brucellosis testing program in winter/spring 1986. The cattle sera were paired with deer samples to represent the same 94 counties and a comparable sex/age distribution. EHD was detected in 5.5% of the cattle sera; BT was detected in only 0.2% (Table 1).

Samples collected in fall/winter 1988-89 documented increased HD activity in deer in contrast to findings in previous years (Table 1). Deer samples (n=291) in 1988 had an overall seroprevalence of 5.8% for BT and 5.5% for EHD; the majority of positive animals were positive for both viruses. Geographic variation was evident (Table 1); the highest seroprevalences detected were in Clay and Jefferson counties, neither of which were included among counties where HD mortality was known or suspected.

Seroprevalence of BT/EHD detected in Illinois is relatively low compared to reported values in cattle and deer in regions where HD is endemic. For example, Odiawa et al. (1985) reported high seropositivity among cattle in Georgia to BTV and EHDV (47 and 42%, respectively) and lower prevalences in white-tailed deer (36 and 34%, respectively). Following an HD outbreak in Montana, seropositivity of EHDV was 73% in mule deer, 5% of white-tailed deer, and 79% of cattle (Feldner and Smith 1981).

Attempts were made to obtain diagnostic specimens for serology and virus isolation; samples were obtained from 13 deer representing 5 counties. Specimens were transported by IDOC field personnel directly to Illinois Dept. Agriculture laboratories at either Centralia or Galesburg, IL. Referrals were then made by these laboratories as appropriate to the NVSL laboratory at Ames, IO. BT Type 17 was isolated from a Macoupin County deer. BT Types 11, 13, and 17 plus EHD Type 2 were detected from 1 of 3 Menard County deer. Samples from 5 other Menard County deer revealed 1 BT (Types 11 & 17) positive, 2 with both BT and EHD (seropositive by AGID), and 1 each positive to BT and EHD, respectively by AGID. Samples from 3 Mason County deer revealed 1 BT and EHD positive by AGID, 1 EHD positive by AGID, and 1 EHD positive by FA test. Although relatively few diagnostic specimens were obtained, an HD outbreak was confirmed and it is clear it involved both BT

and EHD viruses. Mixed infections with both viruses were common. This finding is not unusual because mixed infections have previously been reported for both cattle and deer (Roughton, R.D. 1975, Odiawa et al. 1985).

Geographic distribution of the 1988 HD outbreak in Illinois is uncertain. During the outbreak, field reports of dead deer were obtained from 33 counties (Fig 1). However, subjective review of field reports suggests a more limited distribution of the outbreak with only 15 counties where HD mortality was suspected (Fig 2). The outbreak probably did not include southern Illinois, however, serology data (Table 1) did reveal highest seropositivity in Clay and Jefferson counties.

Submitted field reports of dead deer did not include large numbers; most (5) were reported from a captive herd in Fulton County. Harvest data were compiled by J. Kube (IDOC, Forest Game Biologist) for the 33 counties from which field reports of dead deer were received. Harvest and hunter success in 1987 and 1988 were compared in these counties (Table 2). More permits were issued in 1988 for all counties resulting in increased harvest in all but 4 counties. Percent differences in harvest and hunter success (Table 2) were not substantial and were in accordance with harvest data from other Illinois counties where HD was not reported or suspected. These data suggest that mortality from the outbreak was not substantial; at least it did not impact harvest rates or hunter success. Also, check station operators were instructed to examine harvested deer for evidence of chronic HD; none was reported.

HD activity in the United States was high in 1988. According to reports compiled by the Southeastern Cooperative Wildlife Disease Study (SCWDS unpubl. data), EHD was confirmed in neighboring states of Iowa, Kentucky, and Missouri. Field reports submitted to SCWDS from 44 states revealed HD

activity in 23. Clearly the 1988 outbreak in Illinois was not isolated or unique.

JOB VIC. Analysis and Report

Objective: To integrate published data and findings from this study into management recommendations.

RESULTS AND DISCUSSION

This objective has been met through quarterly, annual, and a final report of findings. In addition, a final report for heavy metals analyses was submitted a part of the Annual Fed. Aid Perf. Rept. W-63-R(SI)-30, Study VI, Job A., 1988. Also, summary reports were provided to IDOC, Division of Wildlife Staff at annual meetings, and in-service training was provided at a Division workshop in May 1988.

Original data and copies of Quarterly and Annual Fed. Aid Performance Repts. are on file at the Cooperative Wildlife Research Laboratory, SIUC, Carbondale, IL 62901.

RECOMMENDATIONS

1. Continue monitoring environmental quality at scheduled intervals to compare findings to baseline data.

2. Continue monitoring the sentinel herd for serological evidence of infectious disease that may pose threat to herd health, the livestock industry, or public health.

3. Monitor deer and cattle for HD activity on a scheduled regional basis to detect endemic areas and better define geographical distribution of HD activity among cattle and deer in Illinois.

4. Increase the scope of surveys to detect/monitor Lyme disease distribution and activity in Illinois.

LITERATURE CITED

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Table 1. Seroprevalence of BT/EHD in Illinois deer and cattle, 1981-1989.

Dates	Species	Location	N	Seroprevalence (%) BT	EHD
Fall 1981	W.T. Deer	Crab Orchard	25	0.0	0.0
	Bovine herd 1	"	24	16.7	0.0
	Bovine herd 2	"	55	14.5	0.0
Fall 1982	W.T. Deer	"	135	3.7[a]	
Fall 1983	W.T. Deer	"	191	1.6[a]	
Fall 1984	W.T. Deer	"	150	0.7	0.0
	Bovine	"	107	0.0	1.9
Fall 1985	W.T. Deer	"	135	0.0	0.0
	W.T. Deer	Illinois[b]	370	0.0	0.5
Wntr/Sp 1986	Bovine	Illinois[b]	400	0.2	5.5
Fall 1986	W.T. Deer	Crab Orchard	190	2.1	1.6
Fall 1987	W.T. Deer	"	170	0.6	0.0
Fall 1988	W.T. Deer	"	152	3.9	3.3
	W.T. Deer	Clay-Jefferson	72	13.9	12.5
	W.T. Deer	Sangamon	23	0.0	4.3
	W.T. Deer	JoDaviess	18	5.5	5.5
Winter 1989	W.T. Deer	Alexander[c]	26	0.0	0.0

[a] - BT/EHD not separated by test procedures.
[b] - Samples from 94 Illinois counties. W.T. deer sera was extracted from deer livers. Cattle sera were obtained from the brucellosis testing program; deer & cattle sera were matched by county, age, and sex.
[c] - Sera collected during a special hunt at Horseshoe Lake Conservation Area, January 1989.

Table 2. Difference between years (1987-88) in deer harvest and hunter success for counties reporting suspected hemorrhagic disease.

County	Harvest & Hunter Success 1987		1988		Percent Difference in Harvest Between 1987 & 1988	Percent Difference in Hunter Success Between 1987 & 1988
Cass	356	(.35)	402	(.39)	+ .13	+ .04
Christian	257	(.53)	292	(.42)	+ .14	- .11
Clark	452	(.52)	475	(.47)	+ .05	- .05
Clinton	375	(.33)	431	(.30)	+ .15	- .03
Coles	190	(.40)	304	(.39)	+ .60	- .01
Edgar	253	(.50)	224	(.42)	- .12	- .08
Fayette	677	(.48)	770	(.48)	+ .14	---
Ford	67	(.41)	65	(.35)	- .03	- .06
Fulton	922	(.43)	969	(.36)	+ .05	- .07
Greene	511	(.53)	615	(.53)	+ .20	---
Grundy	251	(.43)	300	(.38)	+ .20	- .05
Jefferson	610	(.50)	708	(.48)	+ .16	- .02
Johnson	865	(.45)	911	(.42)	+ .05	- .03
Knox	601	(.43)	623	(.41)	+ .04	- .02
LaSalle	392	(.38)	454	(.34)	+ .16	- .04
Logan	182	(.50)	205	(.43)	+ .13	- .07
Macon	82	(.31)	116	(.31)	+ .42	---
Macoupin	507	(.44)	523	(.40)	+ .03	- .04
Marshall	318	(.33)	331	(.32)	+ .04	- .01
Mason	238	(.31)	300	(.34)	+ .26	+ .03
Menard	267	(.42)	257	(.39)	- .04	- .03
Montgomery	356	(.49)	420	(.45)	+ .18	- .04
Morgan	369	(.49)	440	(.46)	+ .19	- .03
Peoria	367	(.35)	469	(.35)	+ .28	---
Sangamon	215	(.40)	299	(.40)	+ .39	---
Scott	300	(.49)	337	(.44)	+ .12	- .05
Shelby	425	(.44)	577	(.42)	+ .36	- .02
St. Clair	378	(.46)	409	(.42)	+ .08	- .04
Tazewell	248	(.38)	357	(.39)	+ .44	+ .01
Union	895	(.44)	955	(.41)	+ .07	- .03
Vermilion	212	(.43)	274	(.38)	+ .29	- .05
Washington	619	(.45)	622	(.40)	+ .005	- .05
Woodford	357	(.43)	340	(.37)	- .05	- .06

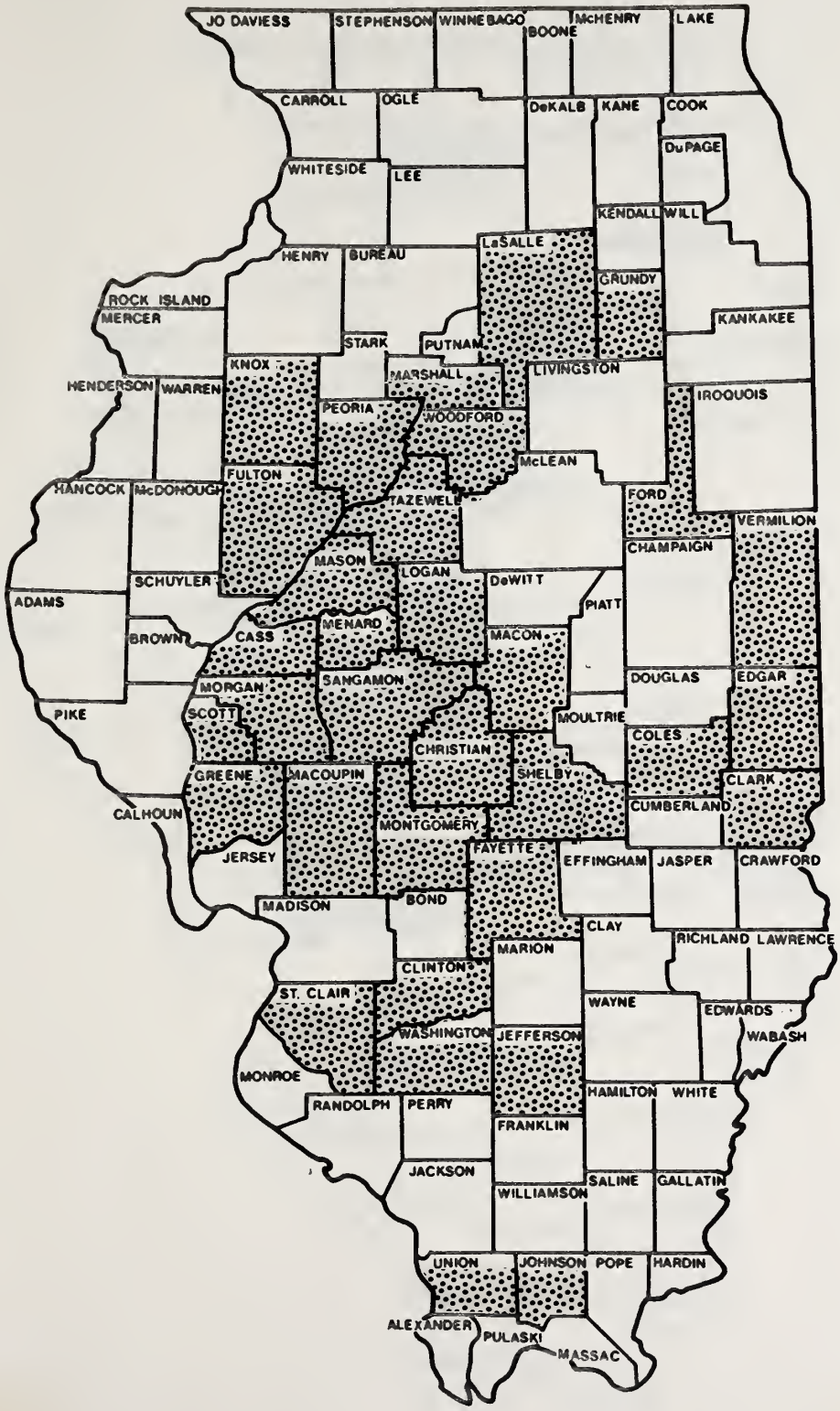

Fig. 1. Counties from which field reports of dead deer were received during the 1988 HD outbreak in Illinois.

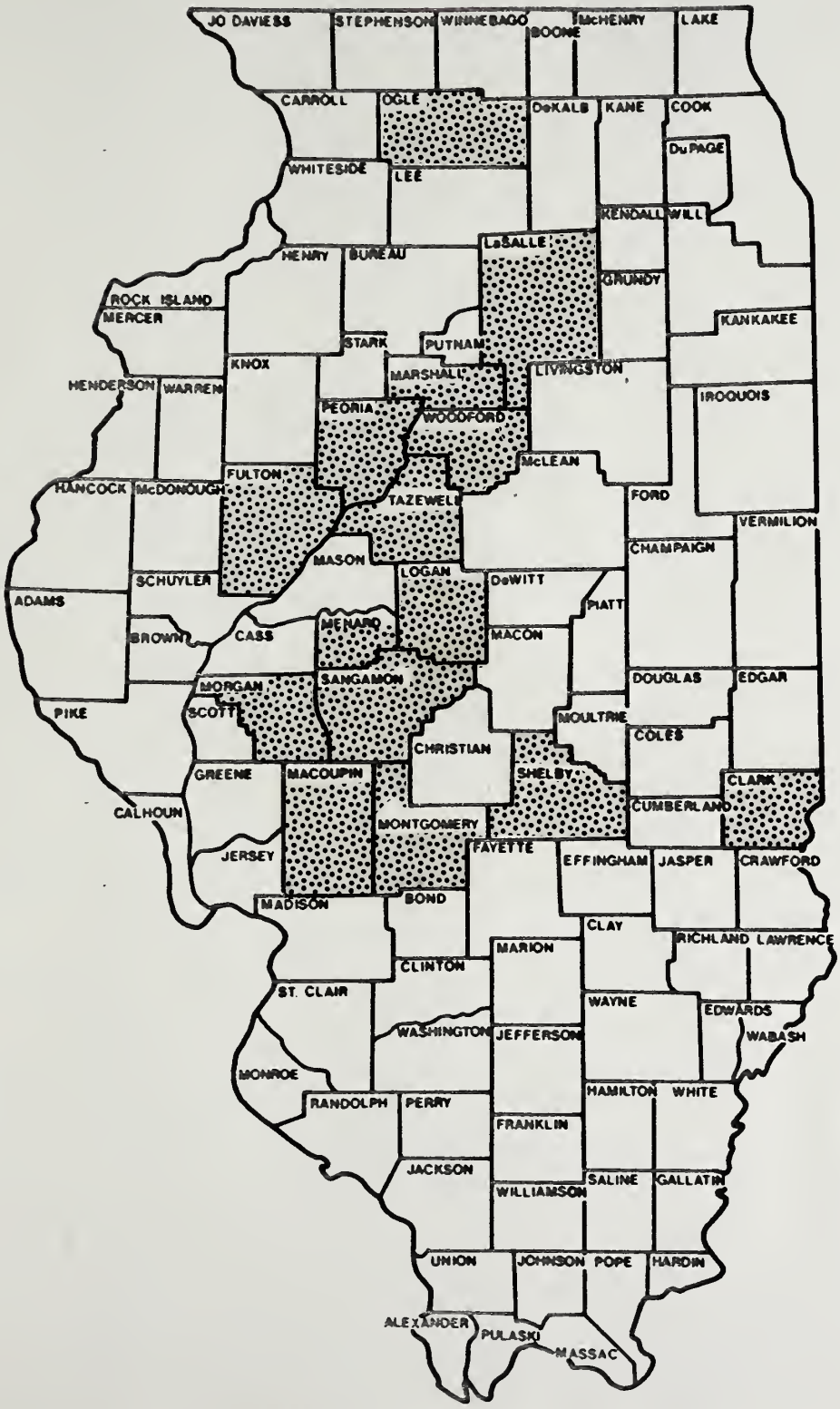

Fig. 2. Counties suspected as being involved in the 1988 HD outbreak in Illinois.